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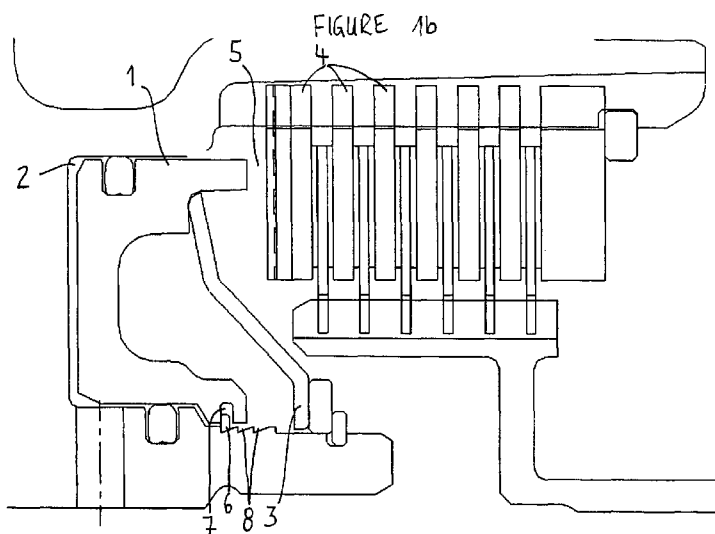
**Declarations under Rule 4.17:**

— of inventorship (Rule 4.17(iv))

**Published:**

— with international search report (Art. 21(3))

(54) Title: AUTOMATIC TRANSMISSION



(57) Abstract: The invention concerns an automatic transmission with a fluid-driven piston for applying clutches, the piston being moveably arranged in a piston chamber, a spring pushing the piston back in its non-applied position. In order to provide an automatic transmission which shows an essentially constant shift time over its lifetime, it is proposed according to the present invention that a retainer element is fixed with a defined play on the free end of the piston and that at least one groove for receiving the lower end of the retainer element is provided on the inner wall of the area behind the piston. The piston only can be displaced forward until the retainer element fixed on the free end on the rear of the piston stops its course and when the spring pushes the piston backwards in its initial position, the retainer element also stops this course when the end of the play is reached.



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**DESCRIPTION****Automatic transmission**

10 The invention concerns an automatic transmission with a fluid-driven piston for applying clutches, the piston being moveably arranged in a piston chamber, a spring pushing the piston back in its non-applied position.

15 In automatic transmissions according to the prior art, pressurized oil is applied on the front side of the piston, the oil pushing the piston against the effect of the spring towards the clutch plates in order to apply the clutch. In the non-applied position, the piston is pushed by the spring against the wall of the piston chamber, whereas in the applied  
20 position it is pushed by the oil against the clutch plates.

The shift time to apply the clutches hereby depends mainly on the gap between the piston and the clutch.

25 Initially, the gap between the piston and the clutch is fixed as the nominal gap to which the necessary mechanical tolerances are added. However, during use of the transmission, the clutch plates wear off, so that the gap between the piston and the clutch increases by the wear of the plates. Due to the  
30 wear of the clutch plates, the shift time increases over the use of the automatic transmission.

It is therefore an objective of the invention to provide an automatic transmission which shows an essentially constant shift time over its lifetime.

5 This objective is achieved according to the present invention in that a retainer element is fixed with a defined play on the free end of the piston and that at least one groove for receiving the lower end of the retainer element is provided on the inner wall of the area behind the piston.

10 The piston only can be displaced by the distance defined by the play of the retainer element: When fluid pressure is applied on the front side of the piston, it moves forward until the retainer element fixed on the free end on the rear  
15 of the piston stops its course and when the spring pushes the piston backwards in its initial position, the retainer element also stops this course when the end of the play is reached. Due to the retainer element, it is further possible to avoid that the piston comes to touch the wall of the piston chamber  
20 at the end of its backward course thereby increasing the lifetime of the piston.

According to the present invention, a lateral opening is provided on the free end of the piston, the higher end of the  
25 retainer element being placed with play into this opening.

The preset play of the retainer element in the opening defines the movement of the piston: it can move forward until the retainer element hits the back end of the opening and  
30 backwards until the retainer element hits the front end of the opening.

A preferred embodiment of the invention consists in the fact that two or more grooves are placed one behind the other one

in the direction of course of the piston, the grooves forming a rack rail in order to allow the retainer element to move only from one groove to the next in forward direction of the piston.

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This feature allows readjustment of the gap between the piston and the clutch plates during use of the transmission: If the wear of the clutch plates becomes too important, the retainer element is pushed by the fluid pressure acting on the piston from the first groove in which it had been placed initially to the second groove thereby readjusting the gap between the piston and the clutch plate. Due to the inclined bottom of the grooves, the retainer element does not return into its initial position when the piston moves backwards; it retains the piston which now only can move as far as the play of the retainer element allows it.

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In the following, the present invention is explained in detail with reference to the drawings in which

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FIGURE 1a shows the assembly according to the prior art,

FIGURE 1b shows the assembly according to the present invention,

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FIGURE 2a shows the forward movement of the piston in an assembly according to the present invention and

FIGURE 2b shows the backward movement of the piston in an assembly according to the present invention.

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In FIGURE 1a, a piston 1 is moveably arranged in a piston chamber 2. A fluid under pressure, e.g. oil, can be applied on the front side of the piston 1 in order to move it forwards

towards the clutch plates 4 against the effect of the spring 3. When the fluid pressure decreases, the spring 3 pushes the piston back until it touches again the back wall of the piston chamber 2. However, the gap 5 between the piston 1 and the clutch plates 4 increases over the time with the wear of the clutch plates 4 so that shift time also increases.

In order to overcome this problem, the assembly has been modified according to the invention as represented in FIGURE 1b. It can be seen that the free rear end of the piston 1 has been provided with a retainer element 6. This retainer element 6 is placed with its upper end into an opening 7 of the free rear end of the piston 1 and with its lower end in a groove 8. It is worthwhile to note that the retainer element 6 has some play; in the present case it has play in the opening 7, but this play could also be in the groove 8. Due to the retainer element 6, the course of the piston 1 is limited to the play of the retainer element 6. Furthermore, the retainer element 6 avoids that the piston 1 hits on its backward course the back wall of the piston chamber 2.

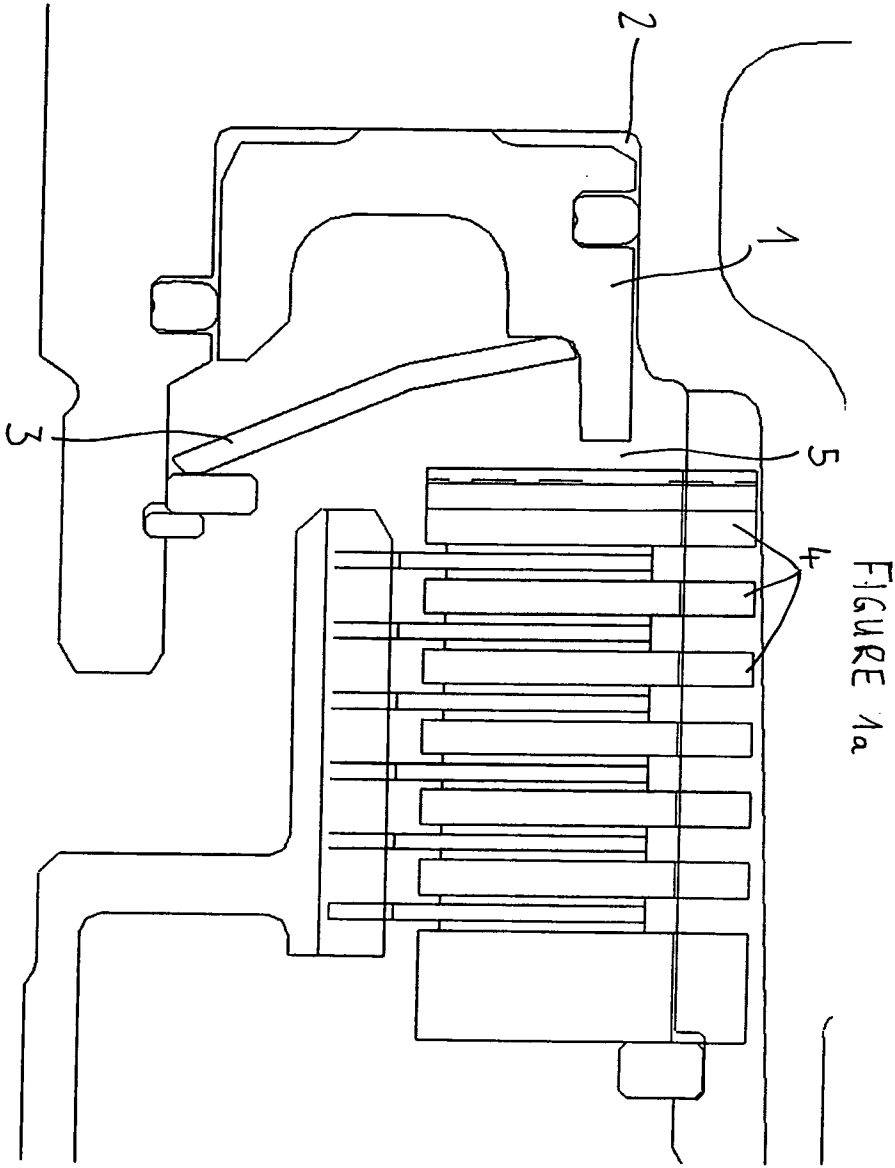
As shown in FIGURES 2a and 2b, three grooves 8 are arranged one behind the other in direction of the forward movement of the piston 1. The grooves 8 form a rack rail so that the retainer element 6 can be pushed from the first to the second groove and from the second to the third groove 8 if the gap between the piston 1 and the clutch plates 4 becomes too important.

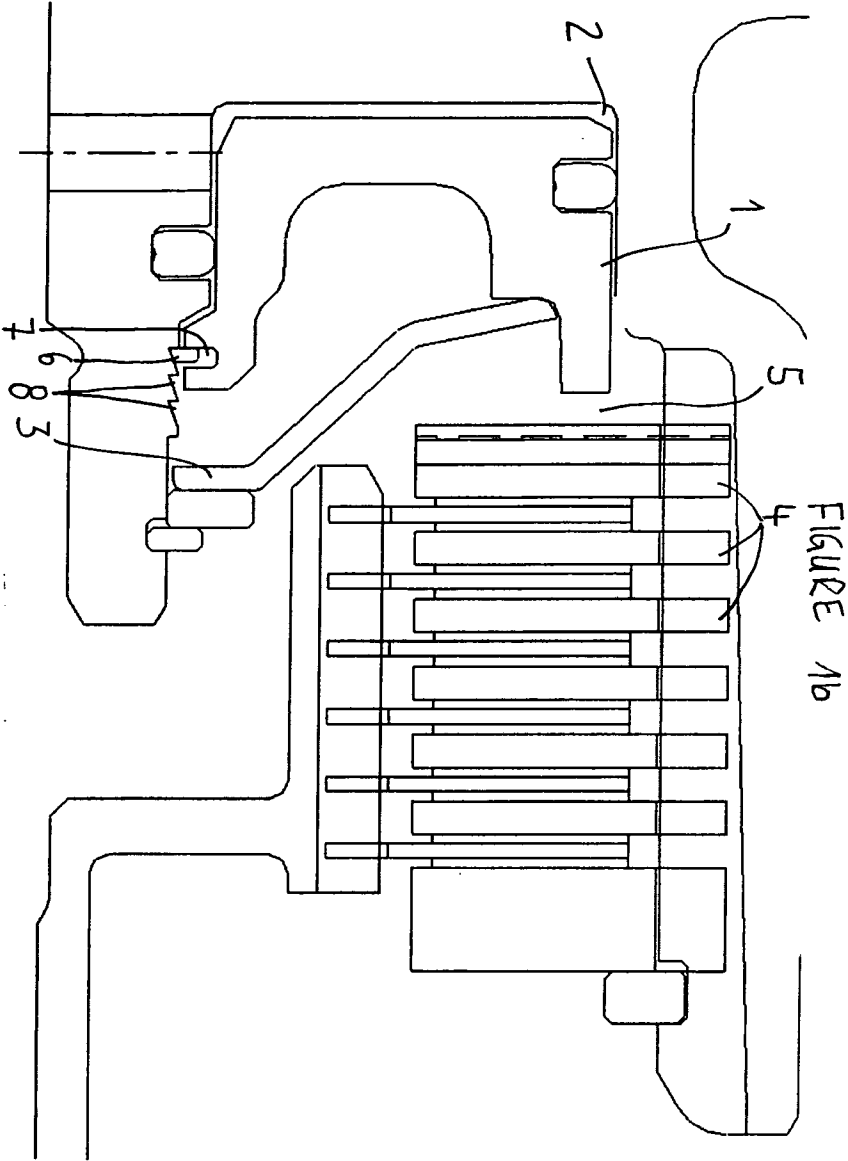
Due to the rack rail form of the grooves 8, the retainer element 6 cannot return in the groove 8 where it has been before upon the backward movement of the piston 1; it progresses only in forward direction, the progress speed of the retainer element 6 compensating the wear of the clutch

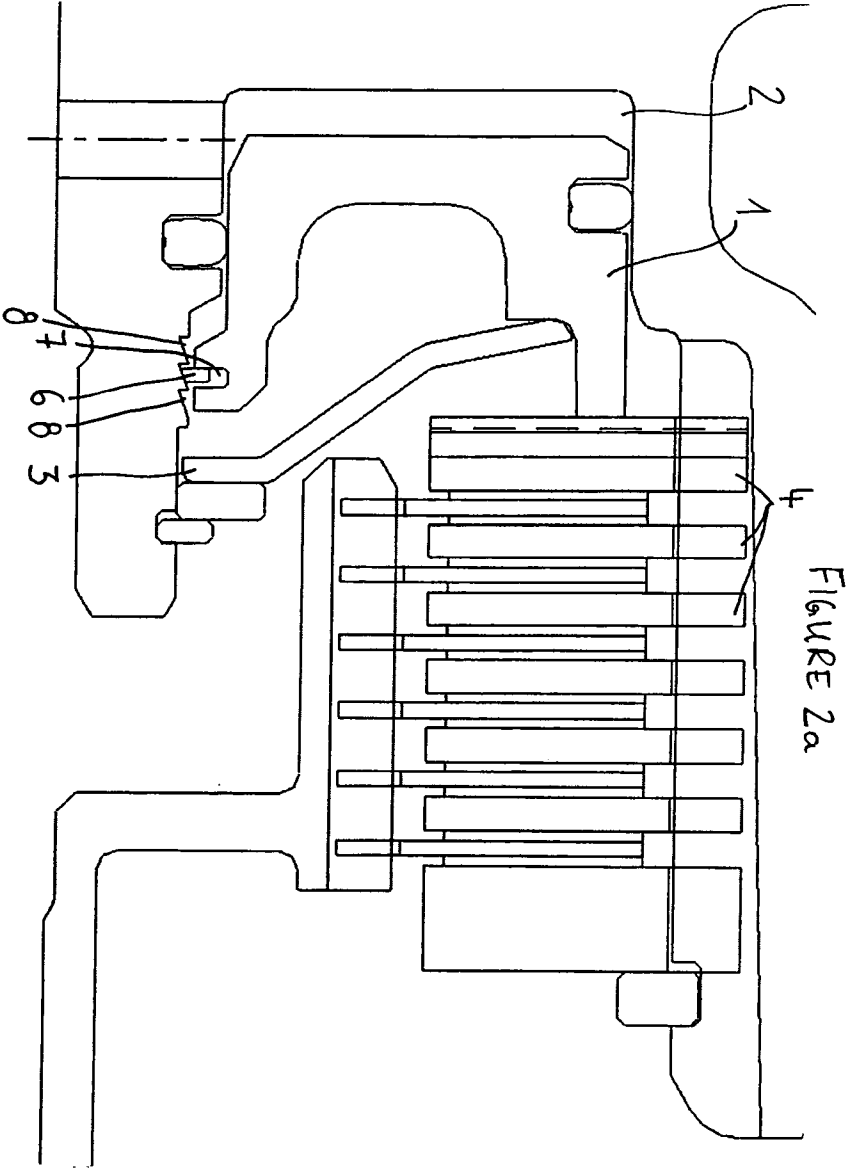
plates 4. This self-adjusting play compensation allows to have a uniform gap between the piston 1 and the clutch plates 4 over the lifetime of the automatic transmission.

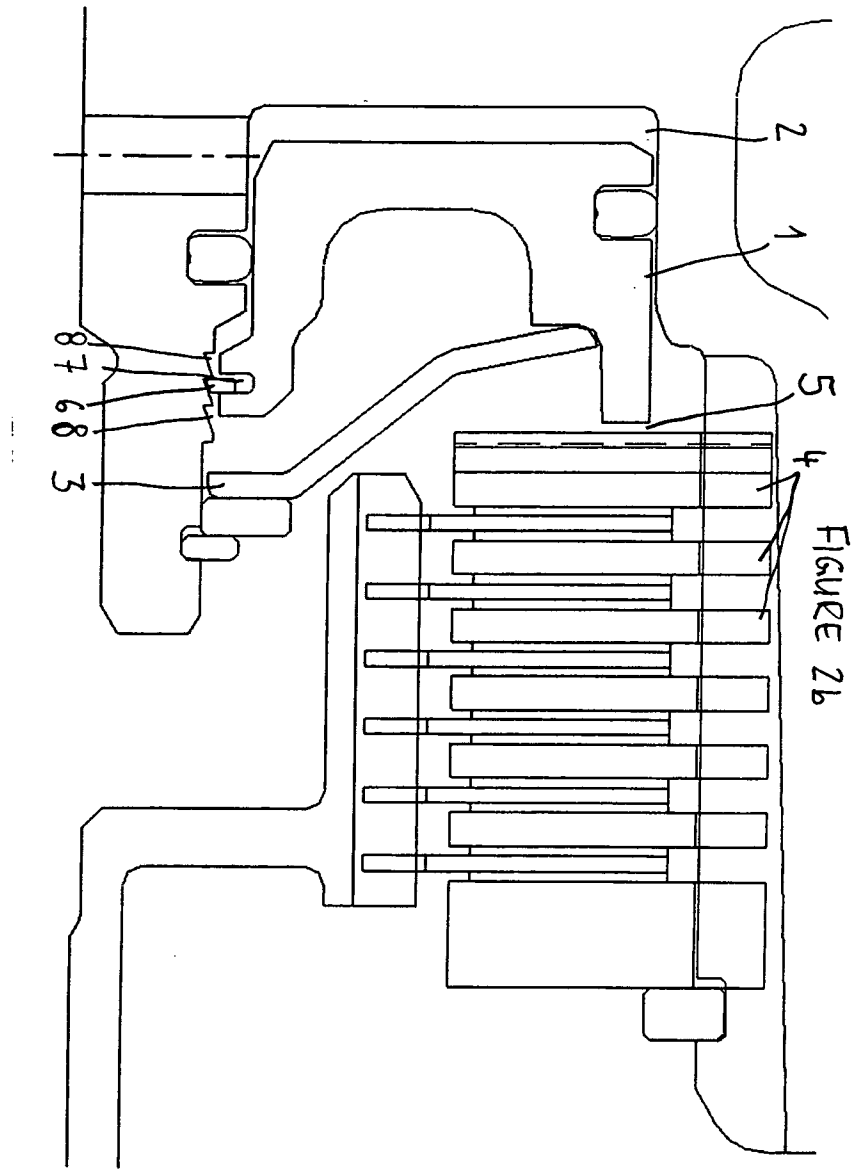
**CLAIMS**

- 5        1. An automatic transmission with a fluid-driven piston (1)  
for applying clutches (4), the piston (1) being moveably  
arranged in a piston chamber (2), a spring (3) pushing  
the piston (1) back in its non-applied position,  
10        **characterized in that** a retainer element (6) is fixed  
with a defined play on the free rear end of the piston  
(1) and that at least one groove (8) for receiving the  
lower end of the retainer element (6) is provided on the  
inner wall of the area behind the piston (1).
- 15        2. The automatic transmission of claim 1, **characterized in**  
**that** a lateral opening (7) is provided on the free end of  
the piston (1), the higher end of the retainer element  
(8) being placed with play into this opening (7).
- 20        3. The automatic transmission of claim, **characterized in**  
**that** two ore more grooves (8) are placed one behind the  
other one in the direction of course of the piston (1),  
the grooves (8) forming a rack rail in order to allow the  
retainer element (6) to move only from one groove (8) to  
25        the next in forward direction of the piston (1).









# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2009/008227

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. F16D25/12 F16D25/0638

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                      | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | EP 0 950 827 A (MANNESMANN SACHS AG [DE])<br>20 October 1999 (1999-10-20)<br>paragraph [0015]; figure 1 | 1-3                   |
| Y         | JP 04 069414 A (MAZDA MOTOR)<br>4 March 1992 (1992-03-04)<br>abstract                                   | 1-3                   |
| A         | US 3 908 804 A (COCHRAN THOMAS E)<br>30 September 1975 (1975-09-30)<br>figure 2                         | 1                     |
| A         | GB 2 300 455 A (AUTOMOTIVE PROD FRANCE<br>[FR]) 6 November 1996 (1996-11-06)<br>figures                 | 1                     |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents :

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"&" document member of the same patent family

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/008227

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s)                     | Publication<br>date                    |
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